MATLAB Algorithms for Rapid Detection and Embedding of Palindrome and Emordnilap Electronic Watermarks in Simulated Chemical and Biological Image Data

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Abstract

Data can easily be hidden in images by using the least significant bits. The most significant bits may be a watermark or annotation which covers the important data.

Routine written in Matlab can be used to generate hidden data in the photographic annotation image.

Introduction

Electronic watermarks are used everyday to protect copyrighted materials on the web. But watermarks can also be used to inform the viewer of data (such as photographs and images) as to important aspects of the image such as ownership, location and environmental conditions during the image's creation.

This paper examines the use of palindrome images, images in which the data can be flipped in the left-right direction and leave the image untouched. This is similar to words such as RADAR which when flipped left right is still RADAR. An emordnilap image forms a totally different images when flipped. This is similar to words such as STOP which when flipped left right gives the new word POTS. Emordnilap is palindrome spelled backwards. This paper explores the use of MATLAB algorithms to rapidly detect and embed palindrome and emordnilap electronic watermarks

Objective

The standard approach (Ref 2-4) to watermarking involves putting the cover image in the first 4 significant bits of each pixel and the watermarked image in four least significant bits. Most watermarking tools look for this pattern. But a new class of image has come to our attention called “palindrome and emordrnilap”. This new type of image may be causing some watermarking detection tools to miss their target.

Data

Photograph of building credit:

Post Office and Custom House, Battery Street, San Francisco

CALL NUMBER: LOT 3544-37, no. 138 [item] [P&P]

Find any corresponding online LOT(group) record

REPRODUCTION NUMBER: LC-USZ62-27229 (b&w film copy neg.)

Method and Results

MATLAB code is given in table marked program 1 and program 2. This is the code that extracts the lower and upper bits in each image and recombines them into the palindrome image or emordnilap image.

Step by step details of the process are given in the Step by Step section.

Program 1. MATLAB Code for watermark_test.m

M file

```
a=double(imread('custom_a.jpg')); %load in image one
b=double(imread('custom_b.jpg')); %load in image two

[I,J,K]=size(a); % save dimensions of both images
% both images used as input are the same size

a=dec2bin(a,8); % change a into binary 8 bits
b=dec2bin(b,8); % change b into binary 8 bits

a=a(:,1:4); % keep the 4 high bits MSB most significant bits
b=b(:,1:4); % keep the 4 low bits LSB least significant bits
a_flip=fliplr(a); % flip the matrix left-right
b_flip=fliplr(b); % flip the matrix left-right
```

```
a_a=[a,a_flip]; % make a palindrome matrix of just a
b_b=[b,b_flip]; % make a palindrome matrix of just b
a_b=[a,b_flip]; % make a emordnilap matrix a with a
                %watermark of b
a_a=bin2dec(a_a); % change a_a from binary to decimal
b_b=bin2dec(b_b); % change a_a from binary to decimal
a_b=bin2dec(a_b); % change a_b from binary to decimal

a_a=reshape(a_a,I,J,K); % reshape to look like a picture
b_b=reshape(b_b,I,J,K); % reshape to look like a picture
a_b=reshape(a_b,I,J,K); % reshape to look like a picture

watermark_flip_display(a_a) % show original & flipped same
pause % pause
watermark_flip_display(b_b) % show original & flipped same
pause % pause
watermark_flip_display(a_b) % original & flipped different
```

MATLAB code to display watermarked images

watermark_flip_display.m

```
function y= watermark_flip_display (watermark_image)
%show that images are palindromes and emordnilaps
image(watermark_image/255) %divide image by 255
axis image % set axis of figure
title(original image') % title
figure(gcf) % pick current figure window
pause % pause
```

```
[I,J,K]=size(watermark_image); % save dimensions of image
watermark_image=dec2bin(watermark_image,8); % change to 8 bit binary
watermark_image=fliplr(watermark_image); % flip matrix left to right
watermark_image=bin2dec(watermark_image); % change to decimal
watermark_image=reshape(watermark_image,I,J,K); %reshape to image size
image(watermark_image/255) % display image
axis image % pick axis and image shape
title('flipped image') % title after flipped left right
figure(gcf) % pick the most current figure window
```

Step by Step description of process for making Palindrome watermark

IR Image of House

Data Decimal & Binary

= 00110101

= 01001110

= 01100100

= 01001011

= 00101111

= 00000111

= 00001011

= 00110100

= 00100110

= 00000101

Annotation Watermark

Data Decimal & Binary

= 00010111

= 01001110

= 01100100

= 00010001

= 00001010

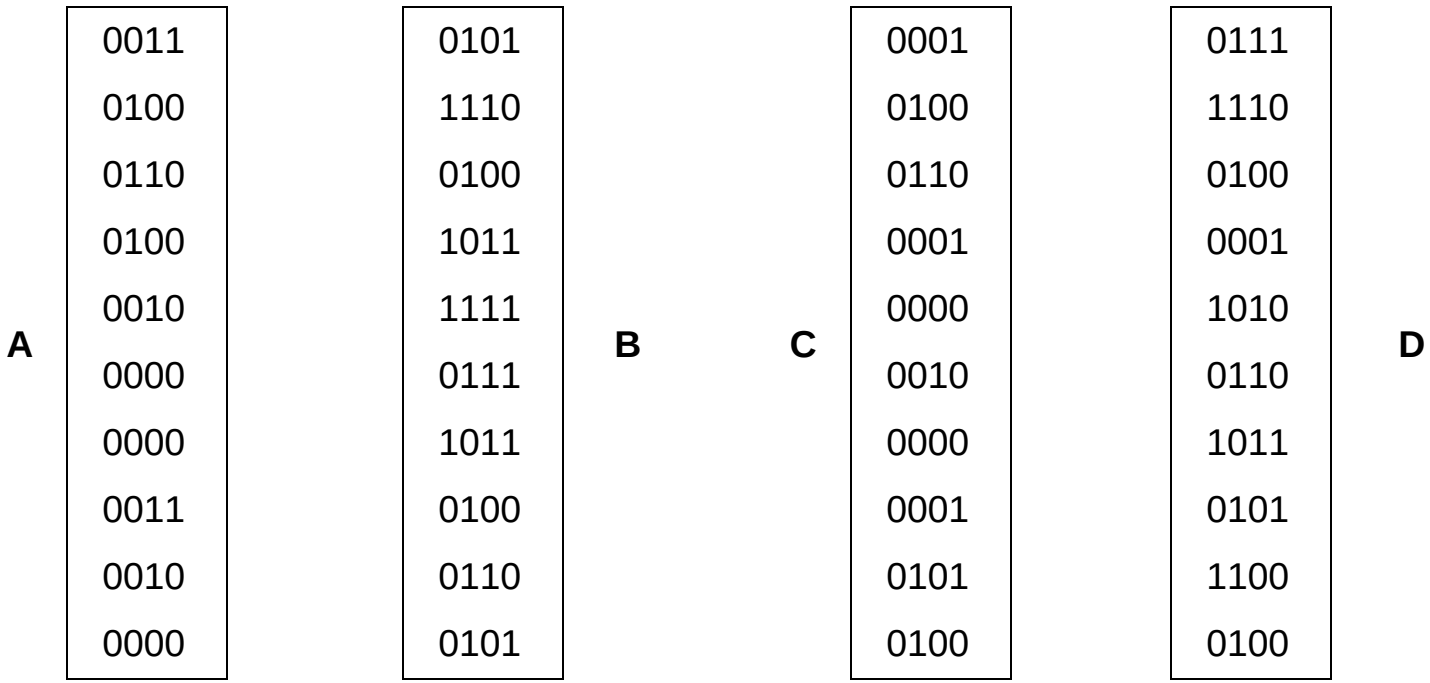
= 00100110

= 00001011

= 00010101

= 01011100

= 01000100



STEP 1

Split Each Matrix in two

Most Significant And Least Significant Bits

B

A_F

1100
0010
0110
0010
0100
0000
0000
1100
0100
0000

1000
0010
0110
1000
0000
0100
0000
1000
1010
0010

C_F

Step 2

Flip Matrix Left-Right

A and C

A_F, C_F means A and C are flipped left – right

A	A_F
0011	1100
0100	0010
0110	0110
0100	0010
0010	0100
0000	0000
0000	0000
0011	1100
0010	0100
0000	0000

W

C	C_F
0001	1000
0100	0010
0110	0110
0001	1000
0000	0000
0010	0100
0000	0000
0001	1000
0101	1010
0100	0010

X

W and X are Palindrome images

A	C_F
0011	1000
0100	0010
0110	0110
0100	1000
0010	0000
0000	0100
0000	0000
0011	1000
0010	1010
0000	0010

Y

C	A_F
0001	1100
0100	0010
0110	0110
0001	0010
0000	0100
0010	0000
0000	0000
0001	1100
0101	0100
0100	0000

Z

Y and Z are Emordnilap images

FINAL STEP

W Palindrome Image Gives upper bits from House No Matter How Flipped

X Palindrome Image Gives upper bits from Watermark No Matter How Flipped

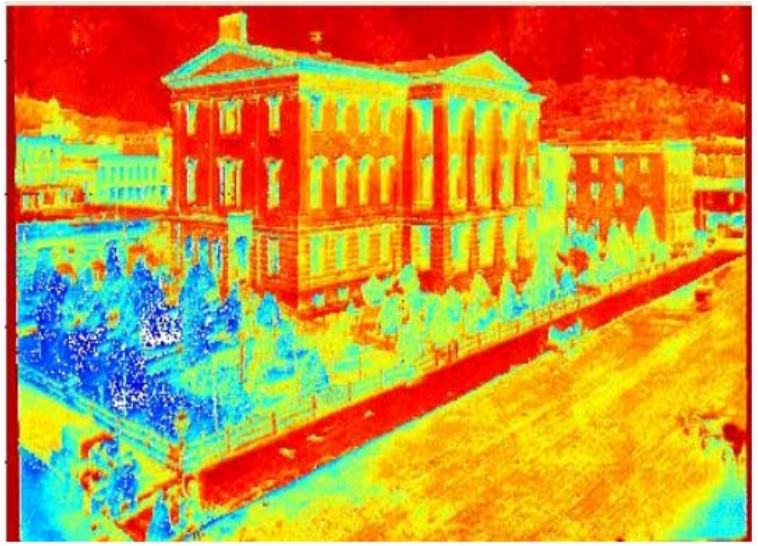
Emordnilap Image

As in STOP=POTS when flipped. Gives House (Y) or Watermark (Z)

Y & Z

A Sample of Data from Each Image

Annotation Watermark



Cover image

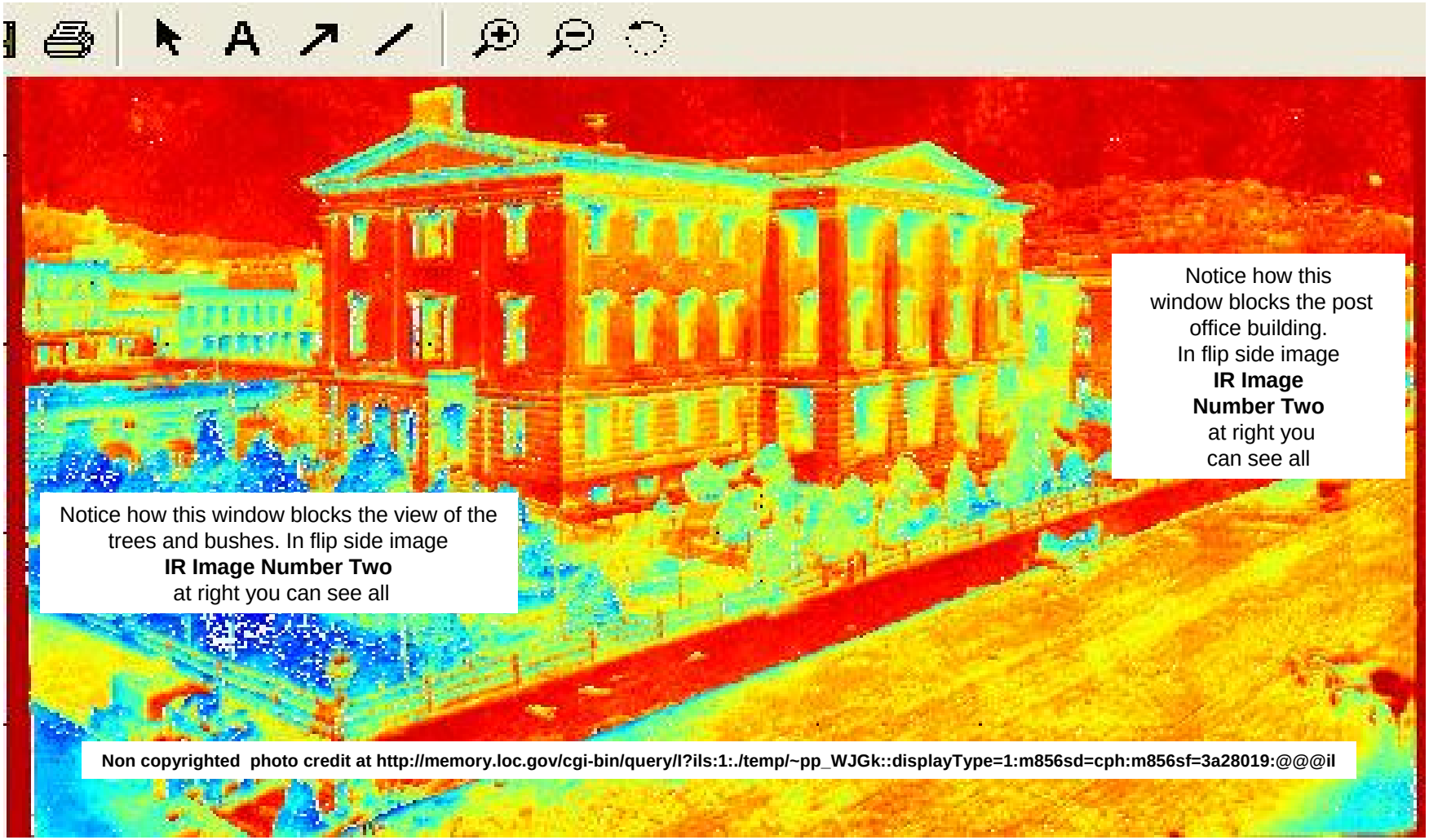
Custom House

Some Data Points from “House” and from “Annotation Watermark” written on Image of House See enlargements next page

Final Result Image

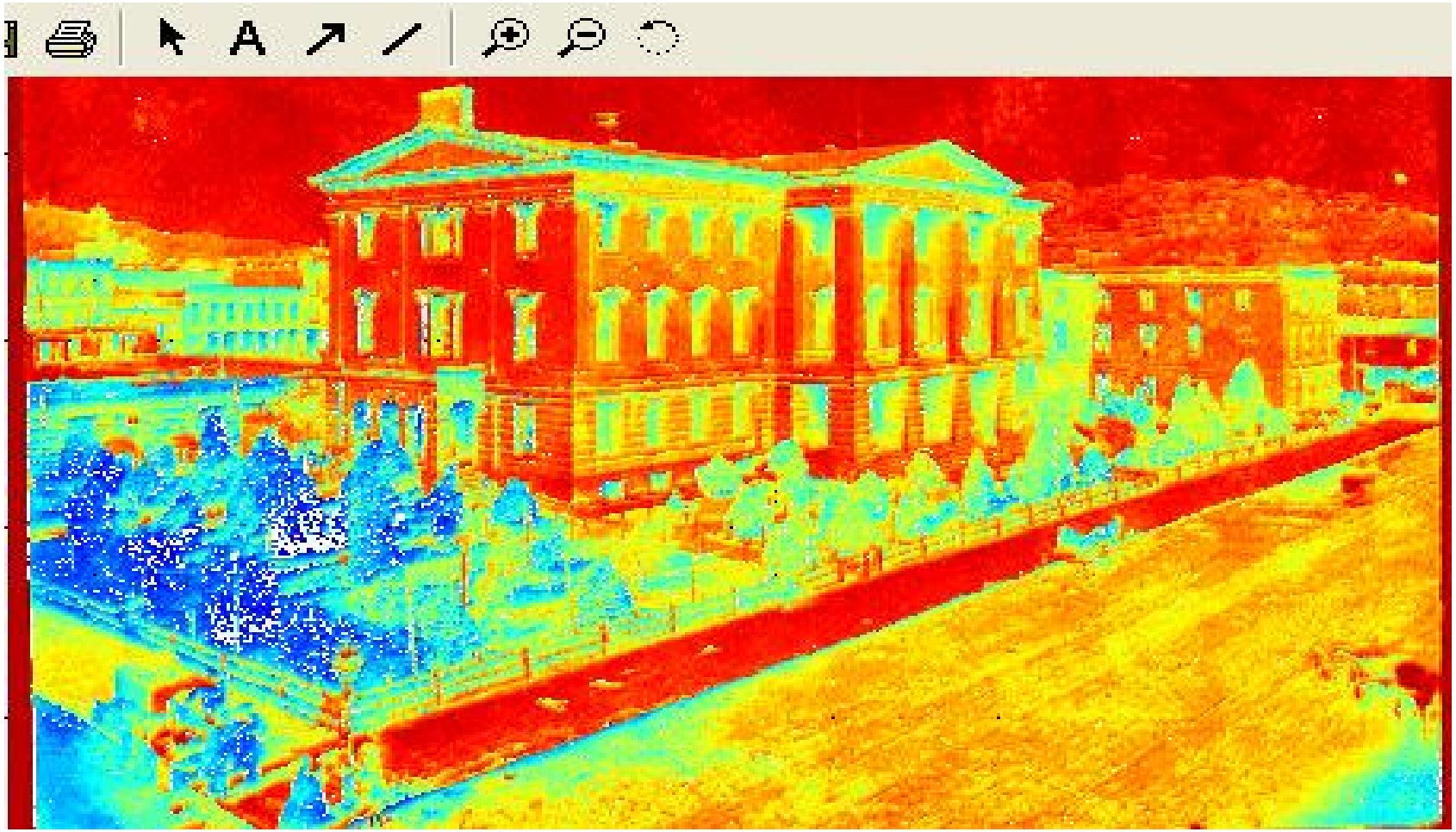
These are Emordnilap images.

The first image is the front and the second is the reverse side of a single jpeg image.



IR Image Number one: **Annotation Watermark**

Watermark showing some the details of the image of the court house and post office blocked from view. These are removed when the image matrix is flipped left to right in MATLAB Also note the photograph credit at the bottom of the photograph



IR Image Number two: Flip Side is the **Cover Image**
Original Photograph: non copyrighted
Located at http://memory.loc.gov/cgi-bin/ query/ r?pp/ils:
@filreq(@field(NUMBER+@band(cph+3a28019))+@field(COLLID+lawhou))

Conclusions

1. Palindrome and Emordnilap watermarking is possible in copyrighted and non copyrighted materials

2. Since they are easily detected, decoded and removed, Palindrome and Emordnilap watermarks are **probably** not the best of ways to watermark the rightful owner's signature showing that this material is his copyrighted work

3. The MATLAB code can easily be paralleled on multiple computers. One computer per image.

References

General Reference

A very good online web reference on Watermarking

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Watermarking Copyrighted Materials

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Special to SPACE.com , 01 July 2003 online @http: //www. space.com /businesstechnology/ technology/ ontheedge_0307.html

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